PERIODICAL ROOM
GENERAL LIBRARY
UNIV. OF MICH.

APR 4 - 1932

SCIENCE

NEW SERIES
VOL. 75, No. 1944

FRIDAY, APRIL 1, 1932

SUBSCRIPTION, $6.00
SINGLE COPIES, 0.15

NEW TEXT-BOOKS

Feldman's Neoplasms of Animals

A MAYO CLINIC MONOGRAPH

Over six hundred specimens have been examined and all varieties of neoplasms are represented in this new book. Each neoplasm is covered thoroughly—definition, general description, histogenesis, incidence, occurrence and points of origin, metastasis and malignancy, gross and microscopic characteristics, diagnostic characteristics, clinical considerations, heredity, transmission, experimental production, technic of transplantation, and bibliography. A final chapter is devoted to the *preservation of pathologic material.*

Neoplasms of Domesticated Animals (A Mayo Clinic Monograph). By **William H. Feldman, D.V.M., M.S.,** Division of Experimental Surgery and Pathology, The Mayo Foundation, Rochester, Minn. With a Foreword by **Charles H. Mayo, M.D.** Octavo of 410 pages, with 193 illustrations. **Cloth, $6.00 net**

Graves' Female Sex Hormonology

This is the first book to give a complete résumé of all the important literature on this subject. Dr. Graves begins his review back in the early literature and then rapidly comes to recent advances. He brings together and clarifies in clinical terms a great amount of material hitherto scattered in many journals throughout the world.

Female Sex Hormonology. Octavo volume of 131 pages, illustrated. By **William P. Graves, M.D.,** Harvard Medical School. **Cloth, $3.50 net**

Burton-Opitz' Elementary Physiology

NEW EDITION

In preparing the *New (4th) Edition* Dr. Burton-Opitz brought his text immediately up to date, adding much new material. The arrangement is logical and orderly, the subject continuously unfolding to the student, each division leading into the next until the study is completed. In this way the student's interest is aroused as to what is to follow.

Elementary Physiology. By **Russell Burton-Opitz, S.M., Ph.D.,** Lecturer in Physiology, Columbia University. 12mo of 410 pages, with 147 illustrations, 28 in colors. **Cloth, $2.50 net**

Greaves' Elementary Bacteriology

NEW EDITION

For the *New (2nd) Edition—entirely reset!*—Dr. Greaves rewrote completely the chapters on classification and chemical composition of bacteria. He added new illustrations and other important material to the sections dealing with milk, butter, water, the bacteriophage, and the part played by bacteria in the arts and industries.

Elementary Bacteriology. By **Joseph E. Greaves, M.S., Ph.D.,** Professor of Bacteriology, Utah Agricultural College; and **Ethelyn O. Greaves, M.S.,** Teaching Fellow, University of California. 12mo of 535 pages, with 138 illustrations. **Cloth, $3.50 net**

.....SIGN AND MAIL THIS ORDER FORM TODAY.....

W. B. SAUNDERS COMPANY, W. Washington Square, Phila.

☐ Feldman's Neoplasms of Animals..... $6.00 net
☐ Graves' Female Sex Hormonology ..... 3.50 net
☐ Burton-Opitz' Elementary Physiology .... $2.50 net
☐ Greaves' Elementary Bacteriology ..... 3.50 net

NAME ..... ADDRESS .....

Entered as second-class matter July 18, 1923, at the Post Office at Lancaster, Pa., under the Act of March 3, 1879.

Two New Lea & Febiger Books

New Work *Just Ready*

A Text-book of HUMAN PHYSIOLOGY

For College Students

By AUGUST KROGH, PH.D., LL.D.
Professor of Zoöphysiology in Copenhagen University, Copenhagen, Denmark

Revised and Edited

By KATHERINE R. DRINKER, A.B., M.D.
Formerly Research Assistant in Applied Physiology, Harvard Medical School

12mo, 233 pages, with 108 engravings. Cloth, $2.75, net

This concise presentation of the subject by a distinguished author brings physiology fully up to date. This revision of the original text has been made to meet the particular needs of American students of college grade.

New Work *Just Ready*

A Text-book of EMBRYOLOGY

By MARY T. HARMAN, PH.D.
Professor of Zoölogy in the Kansas College of Agriculture and Applied Science, Manhattan, Kansas

12mo, 476 pages, with 284 engravings. Cloth, $4.25, net

This book reflects eighteen years of successful experience in teaching embryology to pre-medical students and to students of home economics and physical education. It presents embryology as an anatomical subject, but function as well as structure is emphasized throughout. It removes the student's difficulties in understanding the subject by supplying his lack of knowledge concerning the structure and the working of the fully formed organ or organism.

OUR NEW CATALOGUE IS NOW READY. SEND FOR A COPY TODAY

LEA & FEBIGER

Washington Square
PHILADELPHIA

Please send me books checked:

☐ Krogh $2.75
☐ Harman 4.25

☐ New Catalogue.

Name .....
Address .....

(S. 4-1-32)

BROOKLYN BOTANIC GARDEN MEMOIRS

Volume I: 33 contributions by various authors on genetics, pathology, mycology, physiology, ecology, plant geography, and systematic botany. Price, $3.50 plus postage.

Volume II: The vegetation of Long Island. Part I. The vegetation of Montauk, etc. By Norman Taylor. Pub. 1923. 108 pp. Price, $1.00.

Vol. III: The vegetation of Mt. Desert Island. Maine, and its environment. By Barrington Moore and Norman Taylor. 151 pp. 27 text-figs., vegetation map in colors. June 10, 1927. Price, $1.60.

AMERICAN JOURNAL OF BOTANY

Devoted to All Branches of Botanical Science

Established 1914. Monthly, except August and September. Official Publication of the Botanical Society of America. Subscriptions, $7 a year for complete volumes (Jan. to Dec.). Parts of volumes at the single number rate. Volumes 1–18 complete, as available, $146. Single numbers, $1.00 each, post free. Prices of odd volumes on request. Foreign postage: 40 cents.

ECOLOGY

All Forms of Life in Relation to Environment

Established 1920. Quarterly. Official Publication of the Ecological Society of America. Subscription, $4 a year for complete volumes (Jan. to Dec.). Parts of volumes at the single number rate. Back volumes, as available, $5 each. Single numbers, $1.25 post free. Foreign postage: 20 cents.

GENETICS

A Periodical Record of Investigations bearing on Heredity and Variation

Established 1916. Bi-monthly.

Subscription, $6 a year for complete volumes (Jan. to Dec.). Parts of volumes at the single number rate. Single numbers, $1.25 post free. Back volumes, as available, $7.00 each. Foreign postage: 50 cents.

Orders should be placed with

The Secretary, Brooklyn Botanic Garden
1000 Washington Ave. Brooklyn, N. Y., U. S. A.

MERCK'S INDEX

an Encyclopedia of Drugs and Chemicals

"One of the best handbooks for the advanced student and analyst that was ever compiled. It might well be termed a desk edition of Beilstein, a companion for the expert . . . The references to chemical substances note the atomic arrangement, contain brief descriptions of the properties . . . Special attention should be called to a list of indicators for determining pH concentrations; a short section on qualitative reactions of acids, bases, metals, and salts; reactions of the more important alkaloids and glucosides; and a list of atomic weights brought down to 1929."—*Industrial and Engineering Chemistry.*

4th edition, 1930, 585 pages. 6½ x 9¼ inches. Fabrikoid leather. $5.00; discount of 50 per cent ($2.50) to members of and those associated with the chemical and allied professions.

Send remittance, with identification of sender, to

MERCK & CO. INC.
RAHWAY N. J.

SCIENCE

VOL. 75 FRIDAY, APRIL 1, 1932 No. 1944

The Present State of the Natural Sciences: PROFESSOR ALFRED STOCK 345

Obituary:
In Memory of Robert Koch; A Monument for Ludwig Boltzmann; Recent Deaths 350

Scientific Events:
Investigations of Locusts; The Field Museum of Natural History; California Academy of Sciences Expedition to Revillagigedo Archipelago; Awards of the Elizabeth Thompson Science Fund; Geophysical Research at Harvard University 351

Scientific Notes and News 353

Discussion:
Nature's Moving Picture: ROBERT VAN V. ANDERSON. *The Chemical Nature of Vitamin C:* DR. C. G. KING and DR. W. A. WAUGH. *Studies in Motor and Mechanical Skills:* DR. ROBERT H. SEASHORE and IVAN N. MCCOLLOM. *How Big is a Cell?* DR. EDGAR ANDERSON 357

Scientific Books:
Bobrovnikoff on Halley's Comet in its Appearance of 1909–1911: DR. CHAS. P. OLIVIER. *Howard on the Insect Menace:* DR. E. P. FELT 359

The American Association for the Advancement of Science:
The Host Institution and Hotel Accommodations for the Syracuse Meeting: DR. CHARLES F. ROOS 361

Scientific Apparatus and Laboratory Methods:
The Estimation of the Hydrogen-ion Concentration of the Tissues in Living Animals: PROFESSOR CARL VOEGTLIN and H. KAHLER. *A Culture Medium for Paramecium:* LAUREN E. ROSENBERG 362

Special Articles:
Size of Infection as an Influence on the Persistence of Adult Trichinae in Rats: DR. O. R. MCCOY. *Succession of Forests as Indicated by Fossil Pollen from a Northern Michigan Bog:* J. E. POTZGER 364

Science News 10

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal
Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

THE PRESENT STATE OF THE NATURAL SCIENCES[1]

By Professor ALFRED STOCK

DIRECTOR OF THE CHEMICAL INSTITUTE, TECHNISCHE HOCHSCHULE, KARLSRUHE, NON-RESIDENT LECTURER IN CHEMISTRY AT CORNELL UNIVERSITY ON THE GEORGE FISHER BAKER FOUNDATION

IN inaugurating the series of lectures which I am to give at Ithaca during the following months, my first thought is to express to Cornell University and to my colleagues in the department of chemistry, at whose head stands my friend Dennis, my sincere appreciation of their invitation to come to the university for this term under the George Fisher Baker Foundation. It is a great pleasure and honor to me to have the privilege of spending a few months with my American colleagues and personally to become acquainted with the country which to-day plays a leading part in the world in technical and economic achievement, and in which scientific work has a more assured position than in any other land.

This residence in Ithaca will for me be quite a decided change from my usual habits of life and it will afford me a desired opportunity of making a quiet survey of the present state of natural sciences and technology which to-day is nothing but applied and utilized natural science.

Is one justified in saying that we are now confronted with a crisis in the progress of the exact sciences and technology, a statement that is often heard or read in these days at least in our disrupted Europe? Are the exact sciences really unable to penetrate to the depths of human understanding? Will technology become the scourge of mankind, will it lead to the destruction of our economic life, to the embitterment of the soul? Does salvation lie in recourse to metaphysics or to philosophy?

Natural science, in the modern meaning of the term,

[1] Introductory public lecture.

is but a few hundred years old, although in ancient days there were some very significant technical achievements such as those wonders of the world, the pyramids of the Pharaohs, and a developed technology in ceramics, dyeing and tanning. Astronomy was studied zealously, although chiefly from the astrological side. The alchemy of the middle ages led to the discovery of no small number of chemical facts. But natural science, as we understand it to-day, in which research is carried out not only for practical ends but for its own sake in order to create a well-rounded concept of nature, was developed only on the threshold of modern times. A fresh strong breeze swept through the world and tore down the webs of the Scholastics. Humanism and reformation rendered men's minds receptive to new thoughts and new objectives. The natural sciences devised for their use the instruments without which it was impossible to carry on exact investigation—the clock, the barometer, the thermometer, the telescope, the microscope, the air-pump and many other devices. Men braved the dangers of the sea and gained a knowledge of our earth. Great minds solved the secrets of planetary motion and brought the earth to the modest position that it now occupies in the universe. The alchemical groping among the mysteries of nature was replaced by scientific study, and the invention of printing gave wings to the interchange of thought. Academies of science were founded, and one after another the fields of natural science rose from mere description and empiricism to the discovery and application of mathematically formulated laws. Astronomy and physics were the first to develop. Chemistry and biology followed more slowly. The miracle came to pass that mathematics, apparently the most abstract field of human meditation, proved to be an incomparable aid in the natural sciences and in technology.

The past century brought an astonishing development in scientific and technical methods. While in the past progress had been restricted to a few illustrious leaders, there now arose armies of scientific and technical pioneers equipped with elaborate experimental and theoretical aids. With almost the same methods all civilized countries are now carrying forward scientific research, and while at times there flashes forth the brilliant success of an individual, it is probable that the discovery might eventually have been achieved through the methodical, although slower progress of the many, as Professor Desch also pointed out in his recent lecture here. The leader shows the path and the scientific laborers and builders follow in his footsteps, and there quickly springs up a new settlement where a short time ago there was a trackless desert.

This mass production, however, gives rise to many a difficulty. Scientific and technical literature has increased at such a rate as to be terrifying, and it is difficult to keep in touch with all that has been written even within a limited field. It is almost impossible for scientific journals and works of reference to do justice to their subjects. We look forward to the future with anxiety. Things can not be allowed to go on at this pace. Greater restraint is needed, both in the scope of the work and in publishing. This applies also to the excessive number of conventions and congresses, where often the same questions are discussed over and over again.

On the other hand, however, this great activity and research since the beginning of the present century has led to most remarkable progress in science and technology, as has never before been the case in such a short period. In describing some of the fruits of this time, the present speaker can of course only give a few examples chosen at random.

Physics, through x-ray optics and the more recent electron optics, has greatly extended the earlier field that embraced only visible light and the immediately related field of radiation. The possibilities of these optical methods (in the widest sense of the word) are truly miraculous. They bring us information of what is going on in the most remote sections of the universe, as well as in the interior of the minute chemical atoms; they disclose to us the existence of chemical compounds so short-lived that we can not hope ever to be able to grasp and keep them; they enable us to determine magnitudes that at first seem to have nothing at all to do with optics, as, for example, the measurement of chemical forces.

Electricity has broadened its foundations through the investigation of electrons, which one may regard as the atoms of negative electricity. Every one who enjoys a radio apparatus has some realization of the significance of the discovery and utilization of long-wave electromagnetic rays. Somewhat less comprehensible to lay minds are the equally recent changes in the theoretical concepts of the physicists. Probably the greatest accomplishment in natural science since the days of Copernicus and Newton is the creation of the quantum theory, according to which energy is emitted and received in definite individual portions, or "quanta"-wise, just as the chemical elements occur "atom"-wise. The theory of relativity gave rise among laymen to an unnecessary and excited criticism of their traditional concept of time. Upon the new so-called "wave-mechanics" is based the latest theory of the nature of the atom. The former independence from each other of "mass" and "energy" has now been converted into a mutual relationship. The naïve

chanistic picture of the universe became a victim these revolutions in our physical concepts, and ysics was plunged into a battle of theories and in- pretations that still rages. The old uncertainty as the wave or corpuscular nature of radiant energy s revived. Since it has been shown in America that, n at the high translatory velocity of the earth, the ther wind" has no effect on the velocity of light, the nflict concerning the nature and even the existence the universal ether has broken out anew. In fact, e even hears doubts as to whether the law of cau- lity, that rigid connection between cause and effect, tends to and rules the field of the atom's microcosm. atural science lost one of its most important sup- rts and methods of reasoning when the law of cau- lity was revoked. The present speaker holds with ose investigators who assume that the law of causal- y governs the field of the infinitely minute, and that ly our methods of observation and measurement are ll too coarse to enable us accurately to trace the uses and the effects of these phenomena. Even the eptics hold that under all circumstances "statistical usality" continues to be, in the ordinary physical orld at any rate, the average result of a statistical ural ity.

Modern physics appears to withdraw more and more to the higher sphere of mathematics, and mathe- atics advances to meet it by devising new mathe- atical methods.

Nearly all the other branches of natural science ve been swept along with the tempestuous develop- ents in physics. At many points we see incisive rogress and a breaking away from the older views.

Similar fundamental changes are also apparent in tronomy, the oldest of our sciences. It has greatly xpanded its concepts of the universe, employing that uch-abused term in its true sense. To-day it looks ar beyond our own solar and galactic systems into the ost distant realms of universal space. The fixed ars became the object of precise research concern- ng their chemical composition, magnitude, density, emperature and also their movements. We find many giant stars being assigned densities as low as hat of the earth's atmosphere, while in the case of other stars a tremendous mass concentration must be ssumed. For example, a dark companion of Sirius supposed to possess a density of 50,000. Through odern ideas concerning atomic conversion and the ransition between matter and energy the balance of stronomic energy has received a wholly new expla- ation. That slight shift in wave-length, due to the elative motion of light-source and observer which we all the Doppler effect, has revealed to us the rela- ive movements in the universe. By its aid we have ecognized centers of motion, and have determined some apparently fantastic velocities up to 12,000 kilometers per second. It can here be mentioned that through researches in the physics of electrons it has recently been possible to solve the problem of the earth's aurora borealis and to show that it is an electronic phenomenon caused by the earth's magnetism.

Chemical research has profited particularly from the progress of modern physics. Spectrum analysis, the quantum and the electron theories, together with "wave mechanics," have enabled the chemist to draw up such a picture of the chemical atom as was never dreamed of a few decades ago when it was considered to be a rigid, unchangeable object. Owing to our modern concepts of the atom with its positively charged nucleus surrounded by electrons, it is possible to explain a multitude of apparently unrelated phenomena, such as the spectra characteristic of the individual elements, "ionization" or the occurrence of electrically charged atoms, the possible "activation" of elements by light, electricity and the like, the chemical similarity of certain elements as expressed in the periodic system, atomic disintegration in the radioactive elements and the remarkable phenomena that accompany it, and the existence of isotopes which behave alike chemically, although having different atomic weights. In the "mass spectrograph" we have a surprisingly simple and accurate mean for determining the atomic weight of isotopes.

Reaction velocities, heretofore one of the least understood fields of chemistry, have been opened up for study by these new ideas. As Haber has expressed it, "We have now gained a first impression of the actual nature of the play staged by chemical processes, where before as Schönbein put it, we have known only what happens before the curtain rises and remains when it has fallen." Evidently here the leading parts are played by the activation of the atoms and the "chain reactions" induced by the energy developed in reactions between individual atoms. Band spectra have enabled us to detect the transitory existence of unusual compounds such as hydroxyl and have thus supplied us with an explanation of many hitherto obscure reactions. Great progress has also been made in our knowledge of the special forces acting on a particle on the surface of a substance, where, contrary to the conditions in its interior, there is no longer that uniform effect due to neighboring surrounding particles. This knowledge has illuminated the once dark and obscure fields of colloid chemistry, adsorption phenomena, contact effects and catalysts.

Nor has classic preparative chemistry been inactive. Among its many remarkable successes during recent

years one may mention the preparation of substances of vital importance to the human organism, such as adrenaline from the suprarenal glands, insulin from the pancreatic gland, thyroxine from the thyroid and the vitamins C and D in crystallized form.

Mineralogy has gained a deeper insight of its subject, and to-day directs its attention more to the nature and the arrangement of the smallest structural elements of the crystal lattice than to the external form of the crystal. Our new knowledge concerning radioactivity and the tremendous energy developed by the disintegrating atom has helped geology to secure an essentially different and better founded idea of the nature of vulcanism. The distribution of the chemical elements throughout the various zones of the earth's interior is also much more clearly understood.

Biology is occupied less and less with morphological reasoning and treats biological phenomena as the results of physical and chemical processes. This has made it possible to explain the functioning of the muscles as being relatively simple chemical reactions. The investigation of the hormones, regulators of the most diverse functions of the organism, has made great progress. To mention but a single example: By the aid of the sex hormones, obtained from urine and other substances, it is now possible to direct the development of the individual at will, towards either the female or the male side. One almost shudders in contemplating the fearful power and responsibility thus placed in the hands of the chemist and of the physician.

Enzyme research has shown sound progress. These bodies which in such minute quantities play a wonderful part in the chemical economy of our bodies, in the assimilation of our food and the building up of the body material, have not as yet been isolated in the pure state nor even synthesized. Nevertheless, extensive progress has been made along this path. Methods of purification, concentration and separation have been further perfected by original adsorption methods avoiding chemical changes.

The theory of heredity has opened up a new chapter of great practical significance. Simple regularities, some of which were discovered long ago, have proved to be of fundamental importance for every kind of heredity, in plants, in animals and even in man, as shown, for instance, in the study of hereditary hemophilia. A tremendous amount of observational material about regular and disturbed heredity or mutations, such as can be induced by x-rays, for example, has been investigated. One species of fly, *Drosophila melanogaster*, has attained fame through the service rendered to science by many hundreds of its generations and 20 million of individual specimens. We have come to recognize that the so-called "chromosomes" are the bearers of heredity in the cell, and [illegible] study of their mutual effects has revealed the laws [illegible] heredity. Agriculture has already begun to pr[illegible] from these achievements of biological science.

Progress in healing, due to the achievements of [illegible] natural sciences, has already brought marked leng[illegible] ening of our span of life. In civilized countries [illegible] period has almost doubled during recent yea[illegible] Whether this prolongation is an unmixed bless[illegible] for the inhabitants of this globe—under modern e[illegible] nomic conditions at least—is an open question. A[illegible] other wonderful biological discovery is that of [illegible] so-called "mitogenetic" rays, a radiation of an ult[illegible] violet nature that arises during biological process[illegible] as, for instance, the growth of onion roots or [illegible] development of tadpoles. Although these rays are [illegible] yet not wholly understood, they are expected to sol[illegible] biological problems, such as those of cell divisio[illegible] Perhaps this discovery constitutes the first step in[illegible] a field, so far scarcely considered, that may prove [illegible] special importance for human life: the influence [illegible] electron processes, the activation of molecules, [illegible] effect of radiations and electrical charges on the livi[illegible] organism.

Applied science—technology—at first followed pu[illegible] science with halting steps, but to-day it frequentl[illegible] points out the way to new and valuable lines [illegible] research. When one recalls that the steam engine w[illegible] invented hardly more than one hundred years ag[illegible] the railroad began its service, and cotton came in[illegible] use as a textile fiber, we seem to be dreaming wh[illegible] we think of the modern achievements of technic[illegible] science, such as the vast railroad net covering th[illegible] face of the globe, the miracles of engineering, th[illegible] progress in electricity, aviation and wireless telegr[illegible] phy, and the multiplied yield of the soil. Science i[illegible] tireless in its efforts to advance technology still fu[illegible] ther, to furnish it with the most suitable materi[illegible] for every purpose, to make it independent of natur[illegible] raw materials, to open up new sources of power an[illegible] to simplify and cheapen its work. To-day industry [illegible] clearly understands the great value of scientific re[illegible] search, and it not only has given valuable aid to uni[illegible] versity investigation but has also established excel[illegible] lently equipped research laboratories of its own.

The same efforts towards unification that charac[illegible] terize science and technology are wiping out th[illegible] boundaries between the different natural sciences. This fact strongly characterizes the more recent de[illegible] velopments. Astronomy, physics, chemistry, mineralogy, geology and biology are all merging more and more into one science of nature which everywhere is working with similar experimental and theoretical mathematical means. Physics and chemistry have already become more or less identical.

Even "exact" science and "metaphysical" or mental science bear witness to this modern tendency toward amalgamation. Very significant of this fact was a recent meeting at Prague of physicists, philosophers and mathematicians for mutual interchange of ideas and for general discussions. This being a first attempt, it was not easy to find a common basis of understanding and agreement. But do the different philosophical schools understand one another? It is undeniable that philosophy has already been strongly influenced by modern research in natural science. This influence increases the more, the further the individual branches of natural science progress toward an all-embracing theory of nature. To-day wide circles of philosophers no longer consider their objective as "systems" and philosophical "images of the universe," but a gradual advance in knowledge connected by the natural sciences. Thus philosophy becomes the forerunner and the guide for natural science. Driesch has written: "The philosopher reflects upon what is possible in those fields not yet wholly understood, and that means almost all of them, and submits his results to the investigator for decision. In exchange he continually receives from the investigator new material needing reflection and discussion." According to Russell, philosophy, as well as every other line of research, strives first after knowledge; as soon as final knowledge has been secured in any field, then that is no longer called "philosophy" but becomes an individual science. Formerly the investigation of heavenly phenomena, now called astronomy, was treated as a part of philosophy. More recently the study of the human soul was separated from philosophy and became psychology. "In philosophy," writes Carnap, "we experience the drama, depressing to scientific minds, of seeing a plurality of incompatible philosophic systems being erected one after the other and side by side." Von Mises says: "In aim, subject and method there is only *one* science, namely, the reconstruction of the world through concepts. The division of this science into two parts, into 'mental' and 'natural' sciences is only of a practical and transitory significance, it is not systematic and final." According to Spengler, "the unconscious longing of every true science is directed towards understanding, penetrating and embracing the universe as a whole." Driesch says: "No man is possessed of the pure *will to know*, independent of any practical considerations, to such a degree as the student of nature." Here we have philosophers and mathematicians testifying how far the natural and mental sciences have progressed toward mutual understanding.

Technology also seeks to get into touch with the mental sciences, having wearied of "mechanism," "rationalism," "materialism," or whatever other, once highly esteemed but now much abused, names may be applied to the pursuit of the purely technical. It examines with a critical eye its position within the totality of life and tries to find its place in human culture and economics. An American industrial leader coined the term "human engineering": Technology has to consider the human dignity of labor and how to smooth out the conflict between capital and labor. In the future, successful industrial work will depend more on the handling of men than on the improvement of machines. Plank foresees the development of a "meta-technology" as "the totality of technical economic thought and work, surpassing the limits of that which is based merely on reason and which is expressible in formulas and symbols."

This picture of the present state of the natural sciences, which, on account of the magnitude of the subject and the short time at the speaker's disposal, can be no more than an incomplete sketch, will show the overwhelming life force animating pure and applied natural sciences. There is no hint of weakening, of stopping or of that resignation expressed in Du Bois-Reymond's "Ignorabimus." All along the line there is a strenuous, often a revolutionary struggle for progress, a tendency to clear up contradictions, to unify our ideas regarding nature and the universe, a complete belief in the "possibility of unveiling the truth" and in the existence of "an eternal order that rules the world" (Planck).

Much has been done in the past, more remains to be accomplished. The student of nature should still be as modest as Newton, who said of himself that he seemed to be like a child playing with pebbles on the shore while before him stretches the infinite ocean of the unknown. Although no field of natural science is lacking in vastly important unsolved problems, their outlines are recognizable; and no one knows what lies hidden in the obscurity of the future. If Archimedes escapes death by the rough hand of the soldier, the natural sciences may long continue their triumphant march.

In Ostwald's pyramid of the sciences, sociology stands on the apex. It may be counted as one of the natural sciences, but its subject is the most complicated and incomputable of all natural products. The highest problem for the scientific mind to solve will be—how to free mankind from political, economic and social limitations and how to give it a purer and broader-minded understanding of humanity and sympathetic mutual coöperation.

OBITUARY

IN MEMORY OF ROBERT KOCH

PRESIDENT HOOVER called on the nation on March 21 to join in honoring the memory of Dr. Robert Koch on the occasion of the fiftieth anniversary of his discovery of the bacillus of tuberculosis. The proclamation read:

Fifty years ago, on March 24, 1882, Robert Koch, a German doctor, startled the medical circles of Europe by announcing he had discovered the germ that causes tuberculosis.

The steps he took to prove his opinion, and the clarity with which he explained those steps, made his report not only a classic in medical literature but established a technique in medical research that ever since has been a boon to civilization in its fight against disease.

Next Thursday the fiftieth anniversary of Robert Koch's discovery of the tubercle bacillus will be commemorated throughout the world. Unstinted honor will be paid to the memory of the famous man who, almost single handed, directed the feet of nations toward the path of victory in the relentless, though silent, war against the destructive forces of nature.

In the United States the benefits of Koch's discovery loom large in light of the fact that the death rate from tuberculosis is now but one fourth what it was in 1882, and the search for a specific cure, as yet undiscovered, goes steadily forward along the lines he mapped out.

Because of his priceless contributions to human welfare it is fitting that we, as a nation, do him honor, and that each community acknowledge its debt to Robert Koch by commemorating in an appropriate manner the occasion of the fiftieth anniversary of his discovery of the tubercle bacillus.

A MONUMENT FOR LUDWIG BOLTZMANN

SOME time ago I received a letter from the physicists of Vienna, an abstract of which I am translating herewith:

The Mayor of Vienna has agreed to dedicate a grave of honor to Boltzmann and has agreed to bear the cost of caring for it. Indeed the remains of Boltzmann have already been buried in this tomb, which is situated in the most beautiful and most prominent place in the new part of the municipal central cemetery. While the city bears all the costs—as an exception, even the costs of transfer—it is thought that a monument commensurate with the importance of Boltzmann should be erected.

You will understand without our going into details, that with the present situation in Austria only a small part of the sum necessary for the monument can be collected there. The costs of a monument amount, even with great economy, to about 8,000 to 10,000 Austrian shillings ($1,150 to $1,430). We know that the memory of Boltzmann is still alive in America, as he had been active at the University of California and as some of the influential physicists in American universities and perhaps also in American industry, are students of Bol[t]mann, directly or indirectly.

Our request is now, whether you would use your [in]fluence with the scientists mentioned above and possib[ly] with others, who appreciate Boltzmann's work, to he[lp] in the realization of our plan.

Are there in America large associations (The Amer[i]can Physical Society or The American Mathematical S[o]ciety, for example) who would be inclined to make t[he] erection of the monument possible through larger co[n]tributions?

May we ask you, if this action is successful, to ac[t] as receiver of gifts and keep them until the present ex[-]change difficulties in Austria are over—or the bills fo[r] the monument come due? If you wish, this letter ma[y] be made public.

This letter is signed for the Chemical-Physical So[-]ciety by Professor Arthur Haas, and for the head[s] of the Physical Institute of the Universität o[f] Vienna, and of the Radium Institute of the Academy of Sciences in Vienna by Professor Gustav Jäger, Stefan Meyer, Felix Ehrenhaft, Egon Schweidler and Hans Thirring.

The treasurer of the Johns Hopkins University ha[s] kindly consented to accept contributions for the erec[-]tion of the Boltzmann Monument: Checks may be made payable either to him or to me. Of course, I expect under present conditions only small contribu[-]tions from individuals, and might perhaps suggest $2.00 or $3.00 as a reasonable amount.

K. F. HERZFELD

THE JOHNS HOPKINS UNIVERSITY,
HOMEWOOD, BALTIMORE, MD.

RECENT DEATHS

DR. CLIFFORD RICHARDSON, consulting chemical engineer, from 1900 to 1910 proprietor of the New York Testing Laboratory and earlier superintendent of testing for the Barber Asphalt Paving Company, died in Paris on February 28, at the age of seventy-five years.

CHARLES LIVINGSTON BULL, formerly taxidermist at the U. S. National Museum, author and naturalist, died on March 22. He was fifty-seven years old.

PROFESSOR D. H. MARSHAL, emeritus professor of mathematics and physics, Queen's University, died at Kingston, Ontario, on March 14, at the age of eighty-four years. Professor Marshal was formerly professor of mathematics and physics at the Imperial College of Engineering in Tokyo.

DR. ALEXANDER DOUGALL BLACKADER, emeritus professor of pharmacology, therapeutics and pediatrics, McGill University, died on March 14. He was eighty-six years old.

DR. E. H. GRIFFITHS, physicist and formerly principal and professor of experimental philosophy at the University College of South Wales, died at Cambridge on March 3, at the age of eighty years.

THE death is announced on February 29 at the age of eighty-one years of Dr. George Claridge Druce, curator of the Fielding Herbarium of the University of Oxford.

DR. ADAM SCHWAPPACH, formerly director of the Eberswalde Forest Experiment Station at Eberswalde, Germany, died on February 9, at the age of eighty-one years.

PROFESSOR A. OPPERMANN, director of the Danish Forest Experiment Station at Springforbi, Denmark, died on November 15, at the age of seventy-two years.

SCIENTIFIC EVENTS

INVESTIGATIONS OF LOCUSTS

THE French Committee for Locust Research, consisting of entomologists and chiefs of plant protection services in all the French African Colonies, has agreed to recognize the Imperial Institute of Entomology in London, according to the London *Times*, as the international center for the collection of data on the appearance and movements of locust swarms. This decision follows on the locust conference which was held recently in Rome to discuss methods of international cooperation in locust research, which was attended by British, French and Italian representatives. The Italian delegates agreed to recognize the Imperial Institute of Entomology as the international center for research, but the French delegates were unable to commit themselves without referring the matter to their locust research committee, which has now endorsed the decision of the Rome meeting.

AS a result of this resolution, the Imperial Institute of Entomology will in future receive automatically all the information on locusts available in the French African possessions. This is being regularly transmitted by local authorities to the Algiers Regional Station. French entomologists will also cooperate in the locust investigations in the Timbuctoo area, which British entomologists from Nigeria hope to undertake. This area is strongly suspected to be one of the original sources of the present locust outbreak in Africa.

A general scheme of locust research, which aims at discovering the locusts' permanent breeding areas, is now in operation and is directed from the Imperial Institute of Entomology. This is financed partly by the British African Colonies and partly by the Empire Marketing Board, but, owing to the need for economy, the funds available have recently been reduced by half. Two locust research officers have been appointed. One is now in Uganda advising the government on problems of locust control, and particularly on the failure of poison bait. The other is studying the conditions under which locusts are breeding in the Sudan. Information on the movements of locusts is now being received from 16 empire and 25 foreign countries by the Imperial Institute of Entomology and analyzed there in order to trace the origin of locust swarms, the routes of their invasions, and the probable causes of the outbreaks.

THE FIELD MUSEUM OF NATURAL HISTORY

THE annual report has appeared of Mr. Stephen C. Sims, director of the Field Museum of Natural History, Chicago. He states that despite the economic depression, which naturally has had serious effect upon the museum's finances as upon those of practically all similar institutions, so far as the public is concerned, the museum's services have been maintained with practically no curtailment.

All forms of educational work for both children and adults, such as the public lectures on science and travel, guide-lecture tours, etc., have been carried on as usual. The activities of the unit of the museum organization known as the James Nelson and Anna Louise Raymond Foundation, consisting of entertainments for children, extension lectures in the schools, and other forms of direct contact work between museum instructors and more than 300,000 children, have been increased. Likewise the circulation of some 1,300 traveling exhibits in about 400 schools has been continued without interruption.

Work on the installation of new exhibits and the reinstallation of older exhibits proceeded as usual. The scope of expeditions, however, was reduced and it was in this branch of activity that a large part of the necessary economies were effected. However there were sixteen expeditions in operation, both in America and foreign countries, though most of these were on a smaller scale than those of previous years.

Details of contributions of both funds and exhibition material and lists of the institution's 5,341 members are contained in the report.

The number of visitors during 1931 was 1,515,540, exceeding all previous records. Adding the numbers of children reached by activities conducted outside the museum by the Raymond Foundation and the Harris Extension, the total number of persons directly reached by the museum's educational influence

was more than 2,240,000. Use of the museum library by students and by the public in general increased; more than 93,000 natural history books and pamphlets are now available on its shelves. A new and greatly improved cafeteria was built and opened to the public in the museum building. Reports are included of the Field Museum-Oxford University Joint Expedition to Mesopotamia which is excavating on the site of the City of Kish; the Suydam Cutting zoological expedition to Sikkim, India; a zoological expedition to Indo-China conducted for the museum by Mr. George F. Ryan and Mr. George G. Carey, Jr.; a zoological expedition to central Africa conducted by Captain Harold A. White and Major John Coats; the Marshall Field Zoological Expedition to China; the Third Marshall Field Archeological Expedition to British Honduras excavating ancient Maya sites, and the Field Museum Archeological Expedition to the Southwest excavating prehistoric Indian ruins in Colorado.

CALIFORNIA ACADEMY OF SCIENCES EXPEDITION TO REVILLAGIGEDO ARCHIPELAGO

THE director of the museum and of the Steinhart Aquarium of the California Academy of Sciences, Dr. Barton Warren Evermann, writes that, on the evening of March 10, the *Zaca* passed out through the Golden Gate to enter on a protracted cruise among the Revillagigedos and other islands off the Pacific Coast of Mexico, Central America and Ecuador, in the interest of the California Academy of Sciences. The *Zaca* is the private yacht of Mr. Templeton Crocker, of San Francisco, who is deeply interested in the scientific and educational activities of the academy of whose board of trustees his father, the late Colonel Fred Crocker, was president for many years. The expedition will be known as the Templeton Crocker 1932 Expedition of the California Academy of Sciences. Among those on board besides Mr. Crocker are the following: Captain Garland Rotch, commanding officer; Dr. Albert E. Larsen, ship's doctor; Harry S. Swarth, ornithologist and mammalogist, naturalist-in-charge; John Thomas Howell, assistant curator of the academy herbarium, botanist; H. Walton Clark, assistant curator of the department of fishes, aquatic zoologist and ichthyologist; Robert J. Lanier, assistant superintendent of the Steinhart Aquarium of the California Academy of Sciences, fishery expert; Toshio Asaeda, artist and official photographer, and Maurice Sheppard Willows, Mr. Crocker's secretary, entomologist.

Mr. Swarth recently completed a technical report (Occasional Paper No. 18, California Academy of Sciences) on the land birds of the Galapagos Islands, based upon a critical study of the large collection of 8,691 specimens of birds collected on the 1905–1906 expedition of the California Academy of Sciences to the Galapagos Islands, and the material from those islands in the British Museum and in that at Tring. On the present expedition he will pay special attention to the habits, life histories and ecological relations of the various species. Dr. Larsen will pay special attention to the intestinal and other parasites of the elephant seal and other mammals. Messrs. Clark and Lanier will collect the fishes and other aquatic species. They hope to bring back several large tanks of live tropical fishes for the Steinhart Aquarium, and large series of specimens preserved in alcohol of the fishes, mollusks and crustaceans found in the various regions visited. They will also make complete collections of all obtainable species of marine algae which will be turned over to Drs. Setchell and Gardner, of the University of California, for study and report.

Mr. Howell will study the flora of the various islands and goes prepared to make large and valuable additions to the academy's herbarium already rich in materials from these islands. Mr. Willows will pay special attention to the Lepidoptera, Hemiptera and Coleoptera, groups not well represented in museums in collections from any of these islands. Mr. Asaeda, who was artist and photographer of the recent expedition which Mr. Zane Grey made to tropical islands in the Pacific, is not only a high class artist but also an expert color photographer. He has had much experience in painting fishes and other aquatic animals in life colors.

Mr. Crocker and Captain Rotch also are skilled in moving picture photography. On a short visit to Guadalupe Island last November for the academy, they obtained very interesting reels depicting life of the wonderful elephant seal herd found there.

The present expedition is made possible by Mr. Templeton Crocker because of his interest in the California Academy of Sciences and his desire to assist scientific research through the academy's research departments.

It goes equipped for collecting in all fields of vertebrate zoology and in botany, and will cover the fauna and flora of both land and sea as fully as possible. Specially constructed electrically-lighted traps that can be let down to a depth of one thousand feet will be used for capturing deep sea fishes that, it is hoped, may be attracted by the light. Special dredges that may be dragged on the bottom or at intermediate depths, have been provided. Provision has been made also for regulating the water in the live tanks so that fishes and other species intended for the aquarium can be brought back alive.

This is the second expedition Mr. Crocker has

financed for the academy, the first being that to Guadalupe Island last November. A third expedition chiefly in the interest of the academy was that of Captain G. Allan Hancock's cruiser *Valero III*, to the Galapagos Islands last winter (December to February), with Mr. Alvin Seale and Dr. Leo George Hertein on board representing the academy.

AWARDS OF THE ELIZABETH THOMPSON SCIENCE FUND

PREVIOUS awards from the Elizabeth Thompson Science Fund have been reported in SCIENCE, November 25, 1931, and earlier. Since the last report the following awards have been made:

At the Meeting of February 25, 1932

No. 305 to E. D. Merrill, New York Botanical Garden, $50 to obtain translations of Japanese literature published in Japanese characters, and with Japanese titles, necessary for the preparation of an exhaustive bibliography covering the botanical literature pertaining to Eastern Asia.

No. 306 to W. J. Hamilton, Jr., Zoological Laboratory, Cornell University, $100 toward expenses in making observations on long-tailed shrews of the genus Sorex.

No. 307 to K. K. Landes, University of Kansas, $200 for aid in the study of pegmatite mineral deposits in Colorado and New Mexico.

No. 308 to Carroll Lane Fenton, West Liberty, Iowa, $300 for aid in undertaking the study of a certain group of fossils already described long since but needing a careful re-study to fit them into the whole system of corals.

No. 309 to G. H. Burrows, University of Vermont, $100 for aid in purchasing chemicals and minor pieces of apparatus to be used in the determination of equilibria among reactions of organic chemistry.

The Trustees of the Elizabeth Thompson Science Fund meet ordinarily during the last ten days of the months of February, May and November. Applications for grants should be sent well in advance of the meeting to the secretary of the fund, Dr. Edwin B. Wilson, 55 Van Dyke St., Boston, Massachusetts.

GEOPHYSICAL RESEARCH AT HARVARD UNIVERSITY

AN account is given in the *Harvard Alumni Bulletin* of a project for geophysical research undertaken by the university which will concentrate at the start on data of basic value in seismology, in particular the study of the properties of certain rocks and rock minerals under very high pressures and at high temperatures. The investigation will continue for five years.

The plan is made possible by a gift of $50,000 from the Rockefeller Foundation, $10,000 each year, contingent on the raising of an equal amount from friends of the Harvard departments concerned. The necessary amount for the first year has been obtained from the latter source, and a substantial amount pledged for the other four years.

The work will be administered by the division of geology, under the guidance of an inter-departmental committee consisting of Professor R. A. Daly, of the division of geology, chairman, and Professors P. W. Bridgman, of the physics department, L. C. Graton, of the Engineering School, Harlow Shapley, of the Astronomical Observatory, and D. H. McLaughlin, of the division of geology.

In acknowledging the gift, the committee said: "The opportunity to undertake work in this important field, which is made possible for a period of five years by the generosity of a small group of loyal friends of the university and by the encouraging and stimulating assistance of the Rockefeller Foundation, is a gift of very real value to Harvard."

To accomplish the difficult task of combining high pressures with high temperatures, apparatus is now being designed by Professor Bridgman, under whose direction the research on the elastic properties of rocks and the effects of high temperature and pressure will be carried out. Field measurements of the velocity of seismic waves in rocks of different types are already under way by means of artificially-produced earthquakes of small scale, in carefully selected localities where geologic details are accurately known.

Research will later be undertaken for an improvement of the records of distant earthquakes and in the methods of interpretation thereof.

SCIENTIFIC NOTES AND NEWS

THE fiftieth anniversary of the announcement by Robert Koch before the Berlin Physiological Society on March 24, 1882, of the cultivation of the tubercle bacillus, was celebrated on March 24 at the Rockefeller Institute for Medical Research in New York. The speakers were Dr. Theobald Smith, Dr. Karl Landsteiner and Dr. Simon Flexner.

DR. R. A. DALY, of Harvard University, has been awarded the Hayden Memorial Gold Medal for 1932 of the Academy of Natural Sciences of Philadelphia in recognition of his studies of igneous rocks, the constitution of the earth and other geological researches. The presentation will be made at a meeting of the academy this month.

THE John Scott award for achievement in science, given by the City of Philadelphia, was presented on March 10 to Marchese Guglielmo Marconi, inventor of wireless telegraphy, by Ambassador John W. Garrett.

THE honorary degree of LL.D. will be conferred on May 11 by the University of Manchester on Lord Rutherford and on Sir James Jeans.

PROFESSOR RALPH S. HOSMER, head of the Department of Forestry in the New York State College of Agriculture, has been elected a fellow of the Society of American Foresters. Professor Hosmer is one of thirteen men chosen for this honor since the society was founded in 1900.

THE Sultan of Morocco has conferred the title of Officer of the Order of Ouissam Alouite upon Professor Robert W. Hodgson, of the division of subtropical horticulture in the College of Agriculture of the University of California. The honor was conferred on Professor Hodgson at the request of the French authorities in recognition of his studies of citrus growing in the protectorate.

SIR GEORGE BUCKSTON BROWNE, donor of Down House and of the Royal College of Surgeons Research Farm, Kent, has been elected a member of the Athenaeum Club for distinguished service.

LORD DAWSON of Penn, president of the Royal College of Physicians, and Sir Henry S. Wellcome, founder of the Wellcome Research Institution, have been elected honorary fellows of the Royal College of Surgeons.

THE Cameron Prize for additions to practical therapeutics has been awarded to Dr. Edward Mellanby, professor of pharmacology in the University of Sheffield.

THE progress medal of the Royal Photographic Society of Great Britain has been awarded to Dr. Lüppo-Cramer, head of the photochemical laboratory of the Gelatin Works at Schweinfurt, Germany.

Industrial and Engineering Chemistry reports that at a meeting of the council of the Muslim Association for the Advancement of Science held at Aligarh, India, on December 2, 1931, Mr. H. W. Blood Ryan, controlling editor of *The Chemical News*, London, was appointed vice-president and honorary foreign secretary for Europe in recognition of his work for the advancement of international science. Dr. Ryan was also nominated to a newly established foundation research chair in physical chemistry.

DR. J. BEN ROBINSON, dean of Baltimore College of Dental Surgery, University of Maryland, has been elected president of the American Association of Dental Schools.

IT is reported in *Nature* that at the annual general meeting of the Geological Society of London, held on February 19, the following officers were elected: *President*, Sir Thomas Holland; *Vice-presidents*, Professor E. J. Garwood, Mr. J. F. N. Green, Mr. W. Campbell Smith, Dr. H. H. Thomas, and Professor W. W. Watts; *Secretaries*, Professor W. T. Gordon and Professor P. G. H. Boswell; *Foreign Secretary*, Sir Arthur Smith Woodward; *Treasurer*, Mr. F. N. Ashcroft.

DR. JOHN ARCHIBALD VENN, Gilbey lecturer in agriculture in the University of Cambridge and junior fellow and bursar of Queens College, the son of the late president of Gonville and Caius College, has been elected president of the Queens College, in place of the late Reverend T. C. Fitzpatrick.

THE chair of medicine at the College of France, vacated by the retirement of Professor D'Arsonval, has been filled by the appointment of Professor Nicolle, of Tunis.

DR. J. E. DUERDEN, after serving for twenty-seven years, has retired from the professorship of zoology at Rhodes University College, Grahamstown, South Africa, and also from the directorship of Wool Research for the Union. His future address will be: Wool Research Association, Torridon, Headingly, Leeds, England.

PROFESSOR C. J. CURTMAN, of the College of the City of New York, and Professor Ingo W. D. Hackh, of the College of Physicians and Surgeons of San Francisco, have been appointed members of the editorial board of *The Chemical News*, London.

THE object of the expedition to Peru of Mr. Carl O. Erlanson and Dr. Howard MacMillan was incorrectly stated in a recent issue of SCIENCE. Their object is to study the wild relatives of the cultivated potato in Peru and Chile and to bring back plant material for the possible breeding of disease-resistant strains of the cultivated potato. The expedition is a continuation of the work started the year before last in Mexico and is part of the Department of Agriculture's general breeding program for potato improvement.

DR. WILLIAM B. CASTLE, assistant professor of medicine at the Harvard Medical School, has returned to Boston from Porto Rico where he carried on studies on anemia.

ON March 11, Dr. Joseph Colt Bloodgood, clinical professor of surgery at the Johns Hopkins University School of Medicine, gave a clinic on cancer of the breast at the Duke Hospital, Durham, N. C. On the same date Dr. George R. Minot, professor of medi-

cine at the Harvard Medical School, and director of the Thorndike Memorial Laboratory at Boston City Hospital, lectured before the Durham-Orange County Medical Society, at the Duke Hospital, on "The Treatment of Anemia." He also gave a clinic at the hospital the following morning.

DR. A. C. IVY, professor of physiology and pharmacology, Northwestern University Medical School, Chicago, will deliver the annual Gorgas Medical Society Lecture at the School of Medicine, University of Alabama, on May 7. Dr. Ivy's subject will be "The Physiological Aspects of the Etiology, Symptoms and Treatment of Peptic Ulcer."

DR. DAVID I. MACHT, clinical lecturer at the Johns Hopkins University, was the speaker at a meeting of the Johns Hopkins Chapter of Sigma Xi, held at the School of Hygiene and Public Health on March 21. His subject was "Contributions to Phytopharmacology, or the Applications of Plant Physiology to Medical and Chemical Problems."

THE Sixth Annual Priestley Lectures of the Pennsylvania State College will be given from April 13 to 19 by Dr. Victor K. LaMer, associate professor of chemistry, Columbia University. The subject of the lectures will be "The Physical Chemistry of Solutions."

DR. W. V. BINGHAM on March 18 delivered an Aldred Lecture at the Massachusetts Institute of Technology, the subject being "Adventures in Industrial Psychology."

THE Romanes Lecture for 1932 at the University of Oxford will be delivered by Lord Moynihan on June 1. His subject will be "The Advance of Medicine."

SIR OLIVER LODGE on March 17 delivered the Founders Oration at the University of London. He spoke on "Changes in the Scientific Outlook."

THE executive committee of the American Association for the Advancement of Science will hold its regular spring meeting at the Cosmos Club in Washington on Sunday, April 24, with a morning and an afternoon session. Business to come before the committee at this meeting should be sent to the permanent secretary, Dr. Charles F. Roos, Smithsonian Institution Building, Washington, D. C.

THE fifth International Congress of Entomology will be held in Paris from July 16 to 22, under the presidency of Dr. Paul Marchal, member of the institute and professor at the National Institute of Agronomy.

THE twelfth Congress of Industrial Chemistry will be held at Prague, from September 25 to October 1, under the auspices of the French Society of Chemical Industry and the Chemical Societies of Czechoslovakia. The organization committee in Prague cordially invites all American chemists and technologists who are interested to attend, to present papers and to take part in the functions and discussions. Those desirous of attending may write direct to the Organization Committee, Stepánská 37, Prague II, C. S. R., or to Dr. Jerome Alexander, Secretary American Section, Society of Chemical Industry, 50 East 41st Street, New York City.

THE second Congress of the International Society of Orthopaedic Surgery will be held in London at the Royal Society of Medicine on July 19, 20, 21 and 22, 1933, under the presidency of Professor Nové-Josserand of Lyons.

IN addition to a full year's work in undergraduate courses in inorganic, organic, analytical and physical chemistry, during the eight weeks beginning on June 27, the University of Pittsburgh will offer graduate courses in chemical microscopy, under Dr. E. V. Hjort; quantitative organic microanalysis, under Dr. W. Baldwin; biochemistry and physiological chemistry, under Dr. C. G. King, and modern chemical theories, under Dr. A. L. Robinson. These graduate courses will also begin on June 27, and may be arranged according to the needs of the individual student.

THE department of geography of the College of the City of Detroit is announcing two study field courses for this summer. A course in the geography of Europe, under the direction of Dr. S. Van Valkenburg, is planned for eight weeks beginning on June 18. France, Northern Italy, Switzerland, Belgium and Holland will be visited. The second party, conducted by Dr. Bert Hudgins, will travel by bus, the itinerary including Niagara Falls, New York, Atlantic City, the Shenandoah Valley and the Bluegrass region of Kentucky.

DR. WM. D. REEVE, professor of mathematics at Teachers College, Columbia University, will offer a series of special lectures at the University of Nebraska from June 13 to 24 on methods of teaching mathematics in junior and senior high schools. Dr. Reeve will continue the series of special lectures which was begun last summer by Professor Charles Swain Thomas, of Harvard University, and Dr. W. L. Carr, of Teachers College, Columbia University.

DR. G. W. CONREY, of the Ohio Agricultural Experiment Station and the Ohio State University, gave a lecture on February 15 before the department of geology and geography of Oberlin College on "The Geology of Soils." On March 16 Dr. Walter H.

Bucher, of the University of Cincinnati, spoke to a similar audience on the "Life of Cincinnatian Seas." The third and last lecture in the series will be given on April 25, by Dr. Frank Van Horn, of the Case School of Applied Science, Cleveland, on "The Diamond and Gold Mines of South Africa."

A SERIES of three lectures on bio-electric processes will be delivered at the University of Texas, April 12, 13 and 14, by Dr. E. J. Lund, professor of zoology at that institution. Dr. Lund was named graduate research lecturer for 1931–32. The titles of the lectures are "A New Mechanism for Cell Correlation in Living Organisms," "Control of Current Life Processes by Electric Currents" and "How Does the Living Cell Generate Electrical Energy?"

THE following resolution was recently approved at a meeting of the Board of Overseers of Harvard University: "The faculty of the Bussey Institution having ceased to exist, and there being a desire to retain the degree of master in forestry, voted that the Faculty of Arts and Sciences shall hereafter administer that degree."

TWENTY Columbia professors have became staff members of the New York Post-Graduate Medical School by appointment of the university's trustees. The school has been affiliated with Columbia since last July 1. Those appointed were: Dr. Cameron Bailey, T. Drysdale Buchanan, Dr. John A. Killian, Dr. George Miller MacKee, Dr. Walter T. Dannreuther, Dr. Duncan MacPherson, Dr. Herman O. Mosenthal, Dr. Michael Osnato, Dr. Byron Stookey, Dr. Martin Cohen, Dr. Harold S. Vaughan, Dr. Fred H. Albee, Dr. Warren C. McFarland, Dr. Ward J. MacNeal, Dr. Roger H. Dennett, Dr. Philip R. Lehrman, Dr. William H. Meyer, Dr. John F. Erdmann, Dr. John J. Moorhead, Dr. Joseph F. McCarthy. The school's monthly enrolments since the affiliation with Columbia have totaled 980, as compared with 794 for the nine months preceding the union. Dr. Edward H. Hume is director of the school, and the administrative board, composed of staff members and a group of Columbia officials, now includes Dr. Alan R. Anderson as secretary.

SCIENCE SERVICE reports that the U. S. submarine S-48, carrying a staff of scientists and apparatus designed for measuring the force of gravity under water, arrived at Miami on March 23, ending a cruise among the West Indies begun on February 7. The leaders of the expedition are Dr. Richard M. Field, of Princeton University, and Dr. F. A. Vening Meinesz, of the University of Utrecht and the Netherlands Geodetic Commission. Dr. Meinesz is the inventor of the gravity-measuring pendulum apparatus. "This is the first time we were able to obtain real data which has a bearing on earthquakes," Dr. Field stated. "Dr. Meinesz has developed a specially constructed pendulum to determine gravitation. Once this was determined we were able to speculate as to the character of rock formations, columns of rocks of different kinds having certain gravity. With this certain gravity we can tell what kind of rock should be there and knowing that determine the topography of the sea floor and how it was produced. It will be three months before the field data and preliminary calculations which we have made are computed. From the isostatic reduction of these we can find if certain blocks are in or out of balance and whether they should go up or down." With Dr. Meinesz' apparatus in the submarine, 55 dives were made to approximately 70 feet under the surface. Soundings were made every fifteen minutes coincidentally with the gravitation tests. Four dives were made between Nassau and Miami. Fifty-one dives were made in 33 days from February 7. The cruise made a total of 4,000 miles in three loops. The first was southward of Jamaica and around the west end of Cuba. The second around the Caicos bank through Caicos and Turks Island passage. The third was from Guantanamo through the Bahamas to Nassau and Miami.

THE Universities of Virginia and Michigan are cooperating in an investigation of the chemistry and pharmacology of morphine, with the object of removing the dangerous characteristics of this drug. The research is being carried out under the auspices of the National Research Council through its Drug Addiction Committee. It is now announced that the Rockefeller Foundation will finance the work for three more years. With the funds originally available the committee mapped out a three-year program. At the half-way mark in this program Dr. Charles W. Edmunds and Dr. Nathan B. Eddy, in immediate charge of the work, report satisfactory progress. Nearly one hundred new morphine derivatives and closely related substances have been prepared at the University of Virginia and examined at the University of Michigan. Reports on the chemistry of these substances have appeared from time to time in *The American Journal of Chemistry*, and *The Journal of Pharmacology* will publish shortly two papers on some of the pharmacological results. On the basis of these results the Rockefeller Foundation has taken over the financial responsibility for the work and has granted to the National Research Council funds for its continuance for an additional three-year period. The sum granted not only will provide for the extension of the work to January 1, 1936, but will allow some increase in the yearly budget, so that the investigation can be carried out more vigorously.

DISCUSSION

NATURE'S MOVING PICTURE

IT is a fair question whether there is not something in our attitude toward photographic illustrations that makes us prone to let down exact standards. In scientific literature it is comparatively rare to find photographic reproductions of natural scenes accompanied by the full titles that they deserve. There is no system, and the standards of precision are lax. Even more is this true of general literature, but it is for science to set an example. An appeal is needed for more care and exactness in the titling of such photographs, and particularly for the definite assignment of each scene to its position in space and time.

One is apt to think of scenes as static and to lose sight of the fact that a photograph is a momentary and irreplaceable glimpse of nature's moving picture. If properly documented the photograph becomes a potentially important record of a stage in many dynamic processes. It depicts far more than the special point that the author desires illustrated, and the reader may be more interested in some other feature. To yield the full value with which every true scientist would wish to endow his illustration it must be titled with as great care as devoted to an important specimen. A first essential is that the reader be told where and when the scene transpired.

The publication of photographs in scientific papers is something of a luxury and only selected ones can be reproduced. Hence the more obligation to other sciences and to future generations to conserve all elements of value in the record. Authors and editors might well adopt as an axiom that a photograph is not worth publishing if it is not worth care in giving it a title of general and permanent utility. The statement of particulars as to the locality and time require no more space than the irrelevant or "show-window" verbiage in frequent use.

If one wished to indulge in muck-raking in scientific swamps, examples of offenses and offenders could be brought to light on every hand. The present writer might be the first conducted to the bar of justice. But to avoid personalities the following imaginary, though not exaggerated, example may be cited in illustration: "View looking along a street showing how the people live by making shoes." Here we have the useful information that it is a view and not a smell, that we are looking and not thinking, that it is a street and not a river, that the people are not dead yet, and that we are wrong if we think the industry depicted is merely a favorite national pastime. The reader must hunt through the text to find that the scene is probably somewhere in Tokyo—but possibly in Yokohama—and there is no indication as to whether it is before or after the time of any one of several earthquakes, or the time of a change in the building code, or the advent of a particular social influence. The same picture, now serving merely the passing thought of some geographer of Japanese industry, may contain useful information for present or future geologists, engineers, eugenicists and other scientists if given some such title as the following: *"Tokyo.* Shoemakers' quarter on Momachi Street; N.E. toward Matsu-bashi Bridge in distance. 10 A. M. April 18, 1922." A few months later, in the great earthquake, those people *are* dead, and that scene is gone forever. The event may be extreme, but it serves to emphasize the fact that changes are always in progress, and that unusually great ones may supervene at any moment.

The title above suggested is unnecessarily brief, and additional information could advantageously be given to add to the interest and value of the photograph. But it contains the main essentials, and shows that their presentation is not inconsistent with brevity. Given these particulars, many other relative facts could, if necessary, be reconstituted hundreds of years hence. But without these essentials the illustration may be more a burden to the literature than a boon.

Who can doubt that interest attaches to exactness in recording the time and place of photographs which may contribute to a graphic chronology of processes such as soil erosion, shore-line development, climatic change, or human history? The list of phenomena can be indefinitely extended to the point where practically all photographs would be included. It is to be hoped that a widening appreciation of this function of photography will bring a sense of purpose more broadly scientific than now prevails, not only in the choice and description of pictures for publication, but also in their preservation with full titles in collections and chronologic series.

ROBERT VAN V. ANDERSON

ALGIERS

THE CHEMICAL NATURE OF VITAMIN C

THE concentration of vitamin C from lemon juice has been continued in a manner similar to that recently described by Svirbely and King,[1] with the additional procedure of recrystallization from organic solvents (*e.g.*, ethyl acetate + petroleum ether). The recrystal-

[1] *Jour. Biol. Chem.*, 94: 483, 1931.

lized substance corresponds in chemical and physical properties to a hexuronic acid, and is apparently identical with the hexuronic acid described by Szent-Gyorgyi[2] and reported as a reducing factor in adrenal cortex, cabbage and other sources. Feeding approximately 0.5 mg daily protects growing guinea-pigs from scurvy and permits normal vitality in the animals when on a vitamin C-free diet. A detailed account of the experimental work will be published in the near future, but this involves only a few steps beyond the work previously published.

As in all such work, there is a possibility that contaminating active material has adhered to the crystals fed, but that seems unlikely, since the maximum activity has reached an approximate constant with recrystallization, and much of our previous work has indicated such a chemical nature for the active factor.

The recent report of isolation and synthesis of vitamin C by Dr. Ottar Rygh[3] is not in accord with many of our findings, and we believe his experimental results were misinterpreted. It is perhaps sufficient to point out from his paper: (a) That experimental animals receiving his synthetic o-diphenol derivative of narcotine in addition to their basal vitamin C-free diet survived no longer than those receiving the basal diet only; and: (b) That the animals receiving a partial supply of vitamin C in addition to the synthetic compound showed a physiological response not greatly different from that of the group which received only the partial supply of natural vitamin.

C. G. KING
W. A. WAUGH

DEPARTMENT OF CHEMISTRY,
UNIVERSITY OF PITTSBURGH

STUDIES IN MOTOR AND MECHANICAL SKILLS

RECENT experimental articles and reviews on the field of "mechanical ability" have advanced important experimental data and widely varying interpretations. The latest review by O. L. Harvey[1] suggests possible reconciliations of the divergent views so far published and in closing suggests that "It might be an interesting piece of research to analyze in terms of the tetrad difference technique the data obtainable from a homogeneous group in response to (a) a test of verbal intelligence, and (b) a combined battery including tests such as (1) the Minnesota assembly and spatial relations tests (for mechanical ability); (2) a selected group of Cox's models, explanations, etc. (for mechanical aptitude); and (3) either the Minnesota tests for steadiness, card sorting, packing blocks and tapping, and Link's machine operators' test or some form of motor skills battery, similar to that developed by Seashore (for motility)."

In view of the numerous discussions aroused in these fields of motor and mechanical performances it may be of interest to note that a study which brings together most of these as well as numerous other measures is now in its second year of progress at the University of Oregon with the assistance of grants-in-aid from the National Research Council and the University of Oregon.

The two main objectives of this research are (1) to determine the interrelations of individual differences in fine and gross motor skills with mechanical skills, and (2) to trace the differentiation of fine motor skills in the early years of life. Tests included in this study are the six motor tests comprising the Stanford Motor Skills Unit[2]; the spatial relations tests, assembly tests and paper form boards from the Minnesota Mechanical Ability Tests; measures of postural steadiness, using the Miles Ataxiameter; measures of arm tremor in two dimensions, using the Beall and Hill Ataxiagraph, a graded series of measures of tapping and other hand and arm motions; simple reaction times to light and sound stimuli; the Cozens tests for measurement of general athletic ability; as well as measures of height and weight. Scores on the A. C. E. College Entrance Test are also available for all observers.

By the end of the present academic year the data on these tests should be complete on fifty male university students and it is hoped to continue the study for a third year in order to have one hundred observers. The desirability of using the tetrad difference technique rests largely upon other findings, which will be discussed in a future article.

In previous studies at Oregon boys of age 6, 10, and 15 years were given shorter lists of the same tests, and data on three motor tests given to preschool children at the University of Iowa are also available. Several studies under way are investigating the stability of the individual differences over long periods of time. Two other studies on the prediction of practical skills in typing and handling of knitting machines indicate that the whole field of aptitude hypotheses must be reformulated to determine the relative importance of selecting personnel,

[2] *Biochem. Jour.*, 22: 1387, 1928.
[3] *Zeit. f. Physiol. Chem.*, 204: 105, 1932.
[1] O. L. Harvey, "Mechanical 'Aptitude' or Mechanical 'Ability'?—A Study in Method," *Jour. of Educ. Psychol.*, 22, 517–22, 1931.

[2] Several studies using this battery have demonstrated the high degree of specificity of its component tests. For this reason it should not be considered a test of "motility" as suggested by Harvey. *Cf.* R. H. Seashore, Stanford Motor Skills Unit., *Psychol. Monographs*, 1928, 39, 51–66; and *ibid.*, "Individual Differences in Motor Skills," *J. General Psychol.*, 3, 38–66, 1930.

length of training, and improvements of work methods and conditions.

Robert H. Seashore
Ivan N. McCollom

University of Oregon

HOW BIG IS A CELL?

In classes in elementary biology some attempt is usually made to relate the world revealed by the microscope to the world as we know it with our unaided eyes. In these attempts it has been particularly difficult to compare the scales of the two worlds. For the comparison one needed an every-day object large enough to come within the range of a microscope's field of view. In teaching a class in elementary botany, it occurred to me that the thickness of a page in a book might be so used. The students were asked to determine the figures for themselves, by measuring the thickness of 100 pages of an actual book, dividing by 100 to obtain the value for one page, and then multiplying by 1,000 to convert the reading into microns. Most text-book paper is around 50 microns thick.

In one laboratory course the idea was pushed even further and the students were required during the first exercises with the microscope to rule their drawings with faint lines, 55 microns apart in the scale of the drawing. The finished work then showed what the cells in question would have looked like if seen against the ends of pages in the text-book. I can not be sure that all this was much help to the students, but I have found from experience that it has been very useful to me. Not only has it helped to relate more effectively the two worlds in which I spent most of my time, but it has given me a much better working knowledge of the relative sizes of different plant cells.

Edgar Anderson

Arnold Arboretum
Harvard University

SCIENTIFIC BOOKS

Halley's Comet in its Appearance of 1909–1911. By Nicholas T. Bobrovnikoff. Publications of the Lick Observatory, Vol. XVII, 309 to 482, 1931.

Every one interested in comets to the slightest degree knows of the important papers already published by Bobrovnikoff upon this subject. It is therefore no surprise to find this last perhaps the most complete study of a comet's appearance that has ever been published. Its length and the great detail in which the author describes striking phenomena are justified both by the importance of Halley's Comet, as a typical comet and historically, and by the wealth of data at his disposal.

Working at the Lick Observatory, he used as the basis of his discussion the 438 plates of the comet secured there and 271 selected reproductions from plates taken elsewhere. The former were taken mostly by Dr. Heber D. Curtis, with the writer of the present review much of the time as his assistant. Curtis had intended to work up these himself, but the opportunity for fully doing so never came, though he did publish a preliminary paper (Pub. A.S.P., 22, 117, 1910), and made a number of calculations and notes for the longer one. Therefore Curtis generously turned over everything to Bobrovnikoff, who has, here and there, used some of these calculations in his discussion.

In the space available here, one can call attention to but few of the salient points among the great number of interesting conclusions. The nucleus is proved to have exerted appreciable repulsive forces upon matter forming the jets; in it, however, no rotation was shown, and on several occasions changes of an explosive character were detected therein. For instance, on May 24 a five-fold increase in its size was noted during the exposure of one plate. The threatened breaking up, however, was always followed by a collapse. The jets, composed of cyanogen, were actual matter being expelled. For those in the prolonged radius-vector the nucleus showed repulsive forces of from 1 to 6 times gravitation. The envelopes, in the forms of approximate catenaries, expanded outward at the rate of about half a kilometer per second. The velocity of expansion of the halos was of the same order.

A new determination of the mass of the comet comes out to be of the order of 10^{-10} that of the Earth. This confirms the growing conviction of many of us that some older estimates of the masses of comets were absurdly low. The tail of the comet proved to be double, Tail I having a slight departure from the prolonged radius vector of the orbit, but Tail II making an angle of about 40°. Apparently CO^+ was the chief constituent of Tail I, Tail II shown by diffused solar light and to a lesser degree also by the light of glowing CO^+. In I, the average repulsive forces ranged from 10 to 20, but for the condensations in I these numbers increased to from 20 to 150; in II they were in general < 0.3. He concludes, therefore, that, while the Bessel-Bredichin mechanical theory of comets' tails is sufficient to explain the observed facts, the latter's actual classification is inadequate and that at least four classes are needed, with a great extension of his ideas as to the maximum magnitude of the repulsive forces. It was further shown that not only

the nucleus but even knots in the tails were centers of separate activity and repulsive forces, and finally that the assumption that a mass in the tail moves in a hyperbola is only a first approximation; its actual motions seem to be along a series of short paths, under varying repulsive forces.

Only a few trifling typographical errors were detected. The printing is exceptionally good and, for a technical paper, the style is easy and the statements and conclusions clearly made. As a masterly summary of everything that was learned or inferred from the last visit of Halley's Comet the memoir can be highly recommended to every one. It leaves us, however, realizing more than ever how incomplete is our knowledge of the forces acting within a comet and of how evolution ever formed bodies of this type.

CHAS. P. OLIVIER

FLOWER OBSERVATORY,
UNIVERSITY OF PENNSYLVANIA

The Insect Menace. By L. O. HOWARD. Pages i–xv, 1–347, numerous text illustrations. The Century Company, New York, London, 1931.

THIS is a very readable, interesting account addressed primarily to the thoughtful general public, in spite of the apparently sensational title. The latter is justified by the facts, though comparatively few realize this. There surely is a menace in a group of animals indirectly causing deaths of millions of human beings by disease and starvation. Insects have depopulated considerable sections of the earth and are still maintaining supremacy in certain areas. They certainly can be considered menaces to human welfare.

The author has made a serious effort to interpret to mankind the insect world from the historical or geological, biological and economic aspects, using these terms in a broad sense. This is not a mere discussion of man's history of insects. It outlines the development of this enormous group over a period of forty million years or more and possibly through three hundred million generations, and compares this with the existence of man, extending over some four hundred thousand years and comprising possibly twenty-four thousand generations. It is said that blood tells. Here is a breeding record which shows man as an egotistical upstart, as compared with the earlier, the much more numerous insect dwellers of the earth. In other words, millions of years of existence, the myriad adaptations and the tremendous number of species in all parts of the earth in almost all types of matter clearly demonstrate the ancestral and biological superiority of insects which we, as humans, affect to despise. The evidence forces us to concede biological supremacy to the supposedly lowly insects. The author dwells upon the advantages of the resistant, somewhat elastic, outer walls, known as the exoskeleton to the scientist, calls attention to the great adaptability of insects and also to the extreme prolificacy of these numerous friends and enemies of mankind. In this portion of the book we find many extremely interesting records, not a few of which are relatively new, even to professional entomologists. The book is a remarkable contribution to popular literature on the status of insects and by an outstanding authority in his chosen field. The touch of a master hand and the influence of a broad general knowledge are evident throughout the work.

The problem confronting man, or practical control, is discussed in a comprehensive and extremely interesting manner. Occasional pictures of the experiences of early inhabitants of this country with insects are illuminating and add much to the text. The writer's fifty odd years' experience as a leading economic entomologist in America, in fact in the world, enables him to select the most striking examples of wide-spread depredations, and even death caused by insects. He is better equipped than many another to discuss the basic principles which should be observed in the selection of means for controlling these nefarious and, in some cases, omnipresent pests. There is an interesting and intimate account of the development of quarantine restrictions, with striking sidelights upon the difficulties of enforcing such regulations. There is a discussion of the possibilities and limitations of spraying and the potentialities of biological control. This last appeals greatly to the popular imagination, since it means using insects to kill insects, a subject which is deservedly receiving a great amount of attention at the present time. A distinctly human interest story is related in the account of a search for parasites of the notorious gipsy moth. We find romance in science as well as unselfish devotion to investigation.

There are suggestive accounts of three outstanding efforts to control insects in this country. These deal respectively with the Rocky Mountain locust or Western grasshopper, one of the most terrible pests of the earlier days and even now extremely destructive occasionally, the cotton boll weevil, an outstanding pest in the South in spite of the monument which has been erected to its honor, and the more recent Mediterranean fruit-fly, an introduced insect generally brought to public attention by the press in the last few years on account of its having been discovered in Florida. The excellent series of well-selected illustrations add greatly to the value of the text.

The writer's long experience as a leading economic entomologist and his intimate contacts with leaders in all branches of natural history have enabled him to effectively levy on much general literature usually ignored by specialists, and to cull from such works

many extremely interesting details. He has produced a very readable volume, which deals with the broader phase of our relations to insects in such a way as to command the attention of thoughtful people throughout the world. It is not a volume limited to the entomology of the United States or the entomology of the present day. It is world-wide in scope; it contains gems from the writers of earlier days and much attractive to the general reader interested in an authoritative and entertaining discussion of progress in different lines of science.

E. P. FELT

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE HOST INSTITUTION AND HOTEL ACCOMMODATIONS FOR THE SYRACUSE MEETING

THE Syracuse meeting of the American Association for the Advancement of Science from June 20 to June 25, the ninetieth of the American Association, and the second annual summer meeting of the new series, will be held under the presidency of Dr. John J. Abel. Syracuse University will be the host institution. Dean Hugh P. Baker, the chairman of the local committee for the Syracuse meeting, has supplied the following information regarding the host institution.

Syracuse University occupies approximately one hundred acres of campus on a hill in the southern section of the city of Syracuse. Its buildings overlook the city's business section, and beyond that Onondaga Lake and the rolling country toward Seneca Lake and Lake Ontario. The elevation is 600 feet above sea level, the prevailing summer breezes are cool, and the climate is healthful.

The university was established in 1871 when Genesee College was moved from Lima, New York, and the city of Syracuse bonded itself in support of a larger institution. The university is not under control of any church denomination; among its important extensions are numbered the Medical College, one of the oldest medical foundations in the state, transferred from Geneva, New York; also a university hospital founded by Bishop Huntington, of the Episcopal Church; and the State College of Forestry, affiliated after the non-denominational character of the university was confirmed. Seventeen separate colleges or educational divisions now make up the institution: they are the Colleges of Agriculture, Applied Science, Business Administration, Fine Arts, Medicine, Law, and Teachers College; and the Schools of Citizenship and Public Affairs, Extension Teaching, Graduate School, Library Science, Nursing, Public Speech and Dramatic Art, and the Summer Session. In all these divisions women share equal privileges with men, though the men outnumber the women by about one thousand.

There are thirty buildings on the campus, several of which have been erected in recent years. Among these are the Hendricks Memorial Chapel; Sims Hall dormitory for men; Slocum Hall, which houses the Colleges of Business Administration, Home Economics, Agriculture, and the School of Citizenship and Public Affairs. The New York State College of Forestry has just completed the Louis Marshall Memorial building and the School of Citizenship expects to be housed in the near future in a building which will be started this spring. The departments of zoology, botany, geology and geography and bacteriology are located in Lyman Hall; Bowne Hall houses the department of chemistry. The third and fourth year medical students, as well as the students who graduated from medicine, are taught in the College of Medicine building. The Good Shepherd Hospital is operated in connection with the College of Medicine. These two units provide the necessary class rooms and laboratories and, in conjunction with the many city hospitals, make for a well-rounded medical unit.

The College of Law holds its courses in Hackett Hall, situated across the street from the county courthouse in the down-town district. The other departments of the university, with the exception of the College of Medicine which is located in the down-town district, are conducted in buildings on the campus between University Place and College Place.

Nearly all the freshmen are housed in dormitories either owned or operated by the university. Sims Hall, dormitory for men, is located on the campus and houses 144 students. Opposite the campus on University Place are Reid Hall, Haven Hall and Winchell Hall, and several smaller dormitories for women.

Although the university has a small endowment, the pressure for admittance continues, despite rigid maintenance of academic standards and increase of tuition charges. This fact is explained by the several currents of student life flowing steadily toward the university, including the original stream of Methodist young people from the towns, villages and farms of central New York, and the added stream of students from the high schools of manufacturing cities, many of them choosing Syracuse because of the opportunities for self help in a city of 210,000 people. The

present enrolment is 5,300, exclusive of summer session and extension courses, which bring the total to 10,000.

The administration of the university is encouraging to educational experiment, so that in addition to "projects" now under way at Syracuse supported by four of the great educational foundations, a great deal of reconstruction is going on in curricula, in a cottage system of student housing in individual tutor-adviser work with freshmen, and in a progressive program for intramural athletics.

The Hotel Syracuse has been designated as convention headquarters. The decision has not been made as yet as to whether the university dormitories will be opened for convention guests. Hotel accommodations, together with information concerning the hotels are as follows:

Hotel Syracuse—Harrison, Warren and Onondaga Sts. (608 rooms). Single rooms, $3 to $6.50 per day; double rooms, $4 to $8.50 per day. All rooms with bath.

Onondaga Hotel—Warren and Jefferson Sts. (500 rooms). Single rooms, with or without bath, $2.50 to $6 per day; double rooms, with or without bath, $4 to $9 per day.

Yates Hotel—Montgomery and East Washington Sts. (200 rooms). Single rooms, with or without bath, $1.50 to $3 per day; double rooms, with or without bath, $3.50 to $6 per day.

Jefferson-Clinton Hotel—Jefferson and Clinton Sts. (140 rooms). Single rooms, with or without bath, $2 to $4 per day; double rooms, with or without bath, $4 to $6 per day.

Mispah Inn—Montgomery and Jefferson Sts. (120 rooms). Single rooms, with or without bath, $1.50 to $3 per day; double rooms, with or without bath, $2.5 to $5 per day.

Hotel Hilton—Harrison and Montgomery Sts. (12 rooms). Single rooms, $2.50 to $3.50 per day; double rooms, $3.50 to $5 per day. All rooms with bath.

Hotel Wood—Jefferson and Clinton Sts. (50 rooms). Single rooms, $2 to $3 per day; double rooms, $4 per day. All rooms with bath.

Truax Hotel—Warren and Harrison Sts. (51 rooms). Single rooms, with or without bath, $2 to $2.50 per day; double rooms, with or without bath, $3 to $5 per day.

Kirk Hotel—West Fayette and South Clinton Sts. (3 rooms). Single rooms, with or without bath, $1.50 to $2.50 per day; double rooms, with bath, $4.50 to $ per day.

The evening lectures are to be held in the large auditorium of Syracuse Central High School. The high school is situated between the down-town district and the university and is within easy walking distance of either the hotels or the university campus. All the hotels given above are centrally located and are within convenient walking distance of the Central High School. All are convenient to direct transportation lines to Syracuse University.

We are assured that a sufficient number of rooms will be reserved by these hotels to accommodate those who attend the Syracuse meeting, but in order to save possible disappointment, members are urged to make their reservations at once. These should be sent direct to the hotels selected.

CHARLES F. ROOS,
Permanent Secretary

SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE ESTIMATION OF THE HYDROGEN-ION CONCENTRATION OF THE TISSUES IN LIVING ANIMALS

THE great need for suitable methods for the estimation of chemical potentials in the tissues of living animals was emphasized in previous papers from this laboratory.[1] The purpose of this note is to briefly describe a method for the estimation of pH by means of the capillary glass electrode. Further details concerning this method and its application to biological problems will be published in another paper (Public Health Reports). We have previously called attention to the superiority of the glass electrode over other electrodes for the measurement of pH in biological material.[2] The chief advantage of the glass electrode is that it is not affected by the presence of oxidation-reduction systems which are always present in tissues. Another advantage is that the glass electrode can be given almost any desired shape. For the purpose of measuring tissue pH the capillary type is the best, because the glass capillary can be inserted into any of the soft tissues with a minimum of tissue injury.

Special soda lime glass tubing (No. 015 Corning Glass Works) of the following composition is used: SiO_2 72 per cent., CaO 6 per cent., Na_2O 22 per cent. Tubing of approximately 7 mm outside diameter and 1 mm wall thickness is drawn out to a thin-walled capillary, tapering rapidly from the shank. The latter should be about 20 cm in length. The capillary is severed at a distance of 10 to 15 mm from the shank and the tip is carefully sealed in a flame. The work of Kahler and DeEds[3] has shown that the

[1] C. Voegtlin and Floyd DeEds, Public Health Rep., xliii, 380, 1928; H. Kahler, Floyd DeEds, S. M. Rosenthal and C. Voegtlin, *Amer. J. Physiol.*, xci, 225, 1929.

[2] C. Voegtlin, Floyd DeEds and H. Kahler, Public Health Rep., xlv, 2223, 1930.

[3] H. Kahler and Floyd DeEds, *J. Amer. Chem. Soc.*, liii, 2998, 1931.

elimination of the so-called hygroscopic "deviation film" on the glass surface above the surface of the system whose pH is to be measured greatly improves the reliability of the glass electrode. The lower surface of the shank is therefore coated with a firmly adhering layer of deKhotinsky cement. The shank is partly filled with a phosphate buffer of about pH 7. The electrode is then connected by means of a pressure rubber tubing to a high vacuum pump. With the electrode in a vertical position, the capillary end being at the bottom, the electrode is evacuated. The air in the capillary is thus completely replaced by buffer. Additional buffer is now added, so as to almost fill the inside of the shank. Fig. 1 illustrates the cross-section of the electrode.

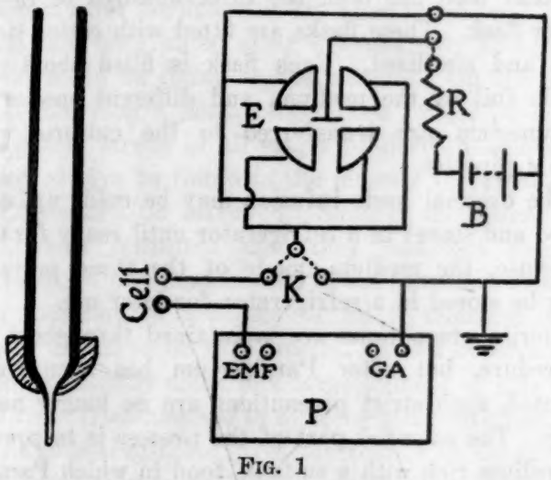

FIG. 1

The next step is to calibrate the electrode by means of two or more pH buffers covering the range of hydrogen-ion concentration of the tissues. We have found phosphate buffers of about pH 7.4 and 6.3, respectively, satisfactory for this purpose. The pH of these standard buffers is carefully determined by the hydrogen electrode at 30° C. The observations of Kahler and DeEds[3] have shown that the potential at an imperfect glass electrode varies slightly if the temperature is raised from 30 to 40°. As the pH of tissues is measured at body temperature, it is therefore necessary to make a temperature correction. This is done by calibrating the glass electrode at 30 and 40° C., or still better at body temperature, in the standard phosphate buffers. Actual experience with several capillary glass electrodes has shown that this temperature correction with phosphate buffers in the physiological range of pH amounts to only a few millivolts. If therefore the electrode is calibrated at body temperature (rectal), it is evident that the error committed can not be significant and certainly will not prevent a fairly accurate measurement of tissue pH. The calibration curve (Voltage—pH) of each glass electrode at body temperature is plotted on coordinate paper. The pH values corresponding to the actual voltage of the tissue at a given time are then read off from these calibration curves.

The animal is given first just sufficient anesthetic (urethane or pentobarbital) for immobilization. The tissue to be measured is exposed, care being taken to avoid bleeding. The surface of the tissue is carefully cleaned with absorbent cotton and the electrode is cautiously inserted and fixed by means of a suitably insulated clamp. The whole length of the glass capillary must be in the tissue. Electrical contact is then rapidly made between the buffer on the inside of the electrode and a saturated calomel half cell by means of a KCl-agar bridge. One end of another agar bridge is placed on exposed and moistened tissue at any suitable part of the animal's body. The other end of this bridge leads to a second saturated calomel half cell. The other electrical connections are shown in Fig. 1. The measuring equipment consists of a Compton electrometer and a Leeds and Northrup type K potentiometer. For purposes of proper screening the animal and potentiometer are placed in a grounded wire cage. During moist weather it is essential to lower the humidity of the room air in order to prevent electrical leaks. This can be accomplished in a manner previously described.[1]

It is obvious that only such potential readings in the tissues are of value which are not accompanied by more than relatively slight time drifts. In numerous experiments done with this new method it was found that careful observation of all necessary precautions will eliminate drifts exceeding those shown in the following table. In some experiments, however, larger drifts occur, and these results are rejected. It appears that this drift may result from the following causes: (1) Injury of blood vessels; (2) imperfect immobilization of the tissue and consequent progressive tissue injury from continuous motion of the electrode in the tissue due to respiratory movements; (3) blood films over the tissue through which the electrode is inserted.

It may be stated, however, that the results as a rule are surprisingly satisfactory, considering the obvious difficulties which are involved in the application of this method. Further work is necessary to ascertain the experimental error of this technique. We believe, however, that sufficient repetition of the measurements of a given tissue with several accurately calibrated electrodes probably involves average errors not exceeding 0.05 pH. The most reliable results are obtained by selecting from a set of electrodes those which give the best results on calibration in the standard buffers, *i.e.*, a nearly theoretical calibration.

To illustrate the technique the results of the fol-

lowing experiments dealing with the estimation of the pH of the Rous chicken sarcoma No. 1 are given.

pH OF ROUS CHICKEN SARCOMA

Subcutaneous tumor No. 1		Subcutaneous tumor No. 2		Large intramuscular tumor No. 1	
Minutes	pH	Minutes	pH	Minutes	pH
1	6.76	3	6.89	2	6.42
3	6.76	5	6.87	4	6.49
5	6.73	7	6.85	5	6.47
8	6.76	10	6.84	9	6.42
11	6.76	16	6.82	13	6.32
13	6.78	30	6.79	16	6.32
		61	6.79	18	6.32
		95	6.80		
		125	6.82		

These results indicate that the Rous chicken sarcoma in the living animal is characterized by an extremely low pH, as compared with that of blood. Work with the Jensen rat sarcoma and the Walker rat carcinoma 256 has also revealed pH values considerably on the acid side of 7. These very significant observations have led us to a systematic investigation of the pH of a great variety of normal and malignant tissues in the living animal.

Since October, 1931, Dr. R. H. Fitch has joined us in this work and we are indebted to him for assistance in the final development of this new method.

CARL VOEGTLIN
H. KAHLER

NATIONAL INSTITUTE OF HEALTH,
U. S. PUBLIC HEALTH SERVICE

A CULTURE MEDIUM FOR PARAMECIUM

THE medium set forth in this article has proven itself to be very satisfactory in the culturing of various species of Paramecium in pure line cultures. The main result of the use of the medium is that the organisms do not exhibit a lowering of their normal metabolism after continuous culturing.

The basic part of the medium is the usual hay infusion of ten grams of chopped timothy hay boiled for fifteen minutes in a liter of well water. This infusion is filtered and sterilized in the Arnold sterilizer at 100° C. one hour a day for three days. It is diluted with nine volumes of sterile well water just before using. Two portions of this infusion are placed in sterile liter flasks with sterile cotton stoppers. One liter is inoculated with *Bacillus subtilis* and the second with *B. coli communis*. A third portion of the medium is made up as follows: Approximately thirty grains of wheat are boiled in a small amount of water for ten minutes. The wheat grains only are then placed in a third liter flask of sterile well water. The three portions are incubated at 37° C. for twenty-four hours, and then combined in one large sterile flask. The medium is now ready for use. The cultures may be used in almost any size of container, but that used has been the three hundred cc Erlenmeyer flask. These flasks are fitted with cotton stoppers and sterilized. Each flask is filled about two thirds full of the medium, and different species of Paramecium are transferred to the cultures with sterile pipettes.

The original basic infusion may be made up, sterilized and stored in a refrigerator until ready for use. Likewise, the medium, made of the three portions, may be stored in a refrigerator for later use.

Sterile precautions are maintained throughout the procedure, but after Paramecium has been transplanted, such strict precautions are no longer necessary. The essential part of the process is to provide a medium rich with a suitable food in which Paramecium will continue to grow normally. With these sterile precautions, other ciliates and flagellates are eliminated. A single organism placed in such a medium will produce a flourishing culture in seven to ten days. One should transplant every two to three weeks. *Paramecium multimicronucleatum, P. bursaria* and *P. aurelia* have been thriving for eight months in this medium.

LAUREN E. ROSENBERG

ZOOLOGY LABORATORIES
UNIVERSITY OF CALIFORNIA
BERKELEY

SPECIAL ARTICLES

SIZE OF INFECTION AS AN INFLUENCE ON THE PERSISTENCE OF ADULT TRICHINAE IN RATS[1]

THE statements that can be found in text-books and published work on trichiniasis regarding the length of life of adult *Trichinella spiralis* are usually quite vague and indicate that wide variations may occur. The usual statement is that the adult worms live for several weeks or longer. Ransom[2] says that adult trichinae of both sexes have been found in the intestine as late as 12 weeks after infection, and that they may commonly be found in large numbers for as long

[1] From the laboratory of parasitology, department of bacteriology, University of Rochester, School of Medicine and Dentistry, Rochester, N. Y. This investigation was aided by a grant from the Rockefeller Foundation.

[2] B. H. Ransom, "Trichinosis," Rep. U. S. Live Stock San. Assoc., pp. 147–165, 1915.

as 7 weeks. On the other hand, Christenson[3] in a series of experimentally infected rats did not find any adults after the sixteenth day and concluded that 16 days is about the normal duration of the worms in the intestine.

In the study of a large number of rats experimentally infected with trichiniasis the writer has found that the size of infection has a great influence on the length of time that the adult worms persist in the intestine. All rats were infected by stomach tube with known numbers of larvae obtained free from infected muscle by artificial digestion. The doses were administered according to the body weight of the animals.

In light infections of 20 larvae per gram, or less, the adult worms were never found in appreciable numbers after the fifteenth day after infection. When these rats were killed after 4 weeks only full-grown larvae could be found in the muscles. On the other hand following a much larger dose (40 or 50 larvae per gram) larvae in all stages of development could nearly always be found in the muscles for as long as 4 or 5 weeks after infection. Some of them were of a size which indicated that they had but recently migrated. Upon examination of the intestines of these rats considerable numbers of adult trichinae were usually found to be still present. These observations were consistently made in a large number of rats that died from trichiniasis 4 to 6 weeks after infection.

The following table gives the results of an experiment in which rats receiving doses of 20 and 50 larvae per gram were killed at intervals up to 3 weeks after infection. Very few adult worms were found in two rats given 20 larvae per gram and killed on the fourteenth day after infection. None at all were found in two more of this group killed on the twenty-first day. On the other hand, 25 to 50 per cent. of the original number of larvae fed were still present as adult worms in the intestines of the rats given 50 larvae per gram and killed after 14 and 21 days.

The most plausible explanation of these observations seems to be that a heavy infection breaks down a resistance in the rats which ordinarily limits the duration of the adult trichinae in the intestine. The size of infection which best illustrates this effect is one which does not kill the rats until after the fourth week. If the infection is too large, the animals die within two weeks in the intestinal stage of the disease. If it is not large enough, the resistance is not broken sufficiently and the animals recover.

No doubt there are other factors, such as diet, health of the animal, etc., which might influence the resistance of the rats and the length of life of the adult trichinae. Other experiments, also, indicate that the infection behaves differently in different hosts. Apparently guinea-pigs have very little resistance against trichiniasis, for the lethal dose of larvae is much smaller than for rats and the adult worms live for as long as 5 weeks following doses as small as 5 larvae per gram. The infection in rabbits, on the other hand, apparently behaves much the same as in rats. It will be interesting to compare the parasitological course of trichiniasis in a larger series of hosts, including man.

These observations that the rat possesses a "normal resistance" against trichina infection fall in line with other experiments[4] which show that rats can develop an immunity to reinfection with *Trichinella spiralis*. They also add to the evidence that has been piling up of late that host factors can play an important rôle in determining the course of helminth infections. In any event, they offer a probable explanation of the variations in the reported length of life of adult trichinae.

O. R. McCoy

TABLE I

SURVIVAL OF ADULT TRICHINAE IN RATS GIVEN DIFFERENT SIZED DOSES OF LARVAE

	No. of larvae fed	Killed—days after infection	No. of adults in intestine	Per cent. of original dose
20 larvae per gram				
Rat no. 1	4,200	5 days	2,960	71
" " 2	4,140	5 "	2,920	71
" " 3	3,540	5 "	2,660	75
" " 4	3,600	14 "	30	1
" " 5	3,900	14 "	570	15
" " 6	4,920	21 "	0	0
" " 7	5,800	21 "	0	0
50 larvae per gram				
Rat no. 8	10,800	5 days	5,220	48
" " 9	9,100	5 "	4,640	51
" " 10	11,500	5 "	6,420	56
" " 11	10,400	14 "	5,700	55
" " 12	12,400	14 "	5,850	47
" " 13	9,800	21 "	4,800	49
" " 14	9,700	21 "	2,400	25

[3] R. O. Christenson, "The Sex Ratio of Adult Trichinae," SCIENCE, 66: 259, 1927.

[4] O. R. McCoy, "Immunity of Rats to Reinfection with *Trichinella spiralis*," *Am. Jour. of Hyg.*, 14: 484–494, 1931.

SUCCESSION OF FORESTS AS INDICATED BY FOSSIL POLLEN FROM A NORTHERN MICHIGAN BOG

THE study of fossil pollen and the history of past forests linked up with it has claimed considerable attention among botanists here and in Europe. The present paper is part of the research on peat from Bryant's Bog, one of the deepest bogs near Douglas Lake, Cheboygan County, Michigan. The work was carried on during the summer of 1931 at the Biological Station of the University of Michigan, under the direction of Professor F. C. Gates.

Bryant's Bog is evidently an old glacial kettle-lake, approximately 65 feet deep. Up to a few years ago the adjacent plain and upland were covered with virgin deciduous forest, most of the region, otherwise, was covered with pine. Collection of peat was made at one foot intervals to a depth of 20 feet.

The customary method of pollen investigation seems to be to boil the peat in KOH to separate the pollen from the débris. The writer tried to avoid this treatment of the peat, as it frequently distorts the pollen grains. Northern Michigan peat is usually very moist and not densely packed, so that the KOH treatment would hardly be necessary. The fossil pollen grains of these bogs are in an excellent state of preservation. The peat was placed in a glass vial as soon as it was taken from the chamber of the borer; separation of the material was made by the addition of distilled water just before the count was made.

In preparing the slide, a scalpel-tipful of peat was moistened with water and the well-stirred mass scraped to one end of the slide while it was being held on a slant. When sufficient liquid had drained from the coarser particles, a cover-glass was placed over the fluid and counting was made from this preparation. An area covered by an 18 x 18 mm cover always permitted a count of 100 pollen grains. Two sets of 100 counts each were made for every level. As specimens of pollen grains of present-day plants were not available in sufficient number of species to make absolute identification of the fossil pollen possible, a comparison was made of the proportions of pollens of conifers and of deciduous trees and herbaceous plants at the different levels in the peat.

Pollen of conifers was very scarce in the upper layers of the peat and very abundant from the 9-foot level on, being most abundant at the 10-foot level. In a way this record presented a remarkable picture of the floristic aspect of the region, both of the present and the past; especially since it correlated with that part of the past which has left other records to the present. Ring counts made by Professor F. C. Gates when the deciduous woods was cut showed an age of 370 to 400 years for the oldest hardwood trees in the region. Assuming approximately 100 years for deposition of two feet of peat, the pollen record showing dominance of the deciduous forest correlates with the time indicated by the ring count. According to the record presented by the deeper layers of peat, conifers controlled the area about 1,000 years ago,

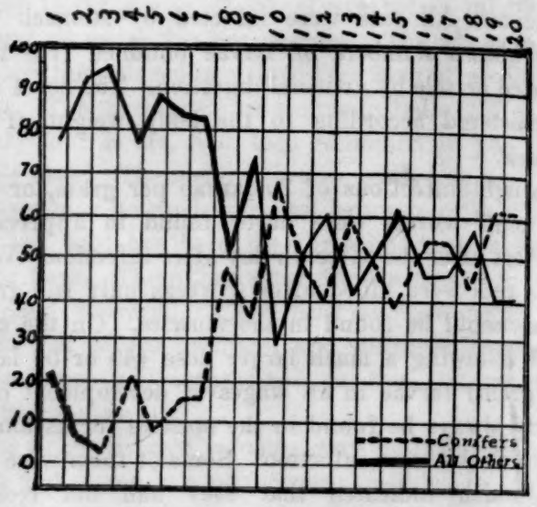

FIG. 1. Showing comparison of the percentage of pollen of conifers against all other pollen present in peat from Bryant's Bog. Horizontal lines percentage pollen. Vertical lines level of peat.

after which for some reason deciduous trees invaded the region and held this position to the time when white men first knew the forest. The sudden dip from coniferous to deciduous pollen dominance between the 9- and 10-foot levels even suggests the possibility that some factor destructive to the then dominant forest aided the invader in rapid ecesis.

J. E. POTZGER,
Research Fellow at Indiana University
BLOOMINGTON, INDIANA

BOOKS RECEIVED

BLANCHAN, NELTJE. *The Bird Book.* Pp. xii + 498. Illustrated by Nellie M. Pairpoint. Doubleday, Doran. $5.00.

BOAS, FRANZ. *Anthropology and Modern Life.* Revised edition. Pp. 255. Norton. $3.00.

COLLINS, A. FREDERICK. *How to Understand Chemistry.* Pp. xii + 322. 31 figures. Appleton. $2.00.

TAYLOR, ALONZO E. *Corn and Hog Surplus of the Corn Belt.* Pp. xxi + 658. Food Research Institute, Stanford University. $4.50.

U. S. TREASURY DEPARTMENT, COAST GUARD. *The "Marion" Expedition to Davis Strait and Baffin Bay, 1928: Scientific Results.* Pp. vii + 81. 50 figures. U. S. Government Printing Office. $.50.

WARMING, EUG. and P. GRAEBNER. *Lehrbuch der Ökologischen Pflanzengeographie.* Pp. 481–720. Illustrated. Von Gebruder Borntraeger, Berlin.